

# THE ARCTURUS OCEANOGRAPHIC EXPEDITION\*

BY WILLIAM BEEBE

(Fig. 1 and Plates A. B. C.)

## OUTLINE

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- III. CHART OF TEMPERATURES OF PACIFIC STATIONS
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- V. RÉSUMÉ OF STATION AND HAUL RESULTS
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## I. INTRODUCTION

The Arcturus Oceanographic Expedition, the ninth expedition of the New York Zoological Society, sailed from Brooklyn on February 11th, 1925, and returned to New York on July 30th. In the interval we steamed a distance of over 13,600 miles, touching at Norfolk, Bermuda, Panama, Cocos Island and the Galapagos. We brought back 11,000 feet of first rate motion picture film, besides a great many colored plates and photographs. We established one hundred and thirteen stations, made hundreds of hauls with nets and dredges, threw overboard two thousand drift bottles containing the usual data.

The avowed objects of the expedition were the investigation of the Sargasso Sea and the mid and deep sea life beneath it, and the study of the Humboldt Current. Owing to continual storms the former was in such a disintegrated condition that I soon decided to postpone detailed study until a more favorable time. In the Pacific, to our surprise, we found that there was absolutely no trace of the Humboldt Current about the Galápagos. The inexplicable absence of this great, cold, Antarctic current was amply compensated for by the equally unexpected presence of unusual natural events.

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Fig. 1. S. Y. Arcturus.



Among the high lights of the expedition may be mentioned the great volcanic eruption on Albemarle Island, the albatross rookery on Hood, the remarkable results of hundreds of dives in a copper helmet and bathing suit in the shark-infested waters about Cocos and the Galapagos, a current rip, temporary and on an enormous scale in mid-Pacific. The accomplishment which, scientifically, proved to be the most valuable of all, was the result of my decision to make a ten-day stay in one spot in mid-ocean, Station 74, sixty miles south of Cocos where continual dredging yielded very remarkable collections of fish and crustaceans, equivalent to any two months of the less intensive work. The crustacea alone taken at this place equalled eighty percent of all the rest which we took in the Pacific.

Accurate accounts in popular language have already been brought out by me in "The Arcturus Adventure" published under the auspices of the Zoological Society by G. P. Putnam's Sons, New York City, a companion volume to "Galapagos: World's end."

The origin and evolution of life, men and expeditions are interesting. On the very day of my return from the Galapagos in the *Noma*, I was introduced to a recently elected member of the Board of Managers of the Zoological Society, Henry D. Whiton. Mr. Whiton said to me, "You seem tremendously interested in the Galapagos; if you ever want to go back there I will furnish the steamer if you can get someone else to provide the coal." So from this generous, tentative beginning there crystallized the twenty-four hundred ton steam yacht *Arcturus*, the specified coal, a splendid oceanographic outfit, a captain and a crew, and an expedition of six months' duration, which steamed from New York to the Sargasso Sea, thence to Cocos and the Galapagos, and which secured a host of treasures, from the most microscopic beings which contribute to the surface luminescence of the sea, to a giant devilfish weighing more than a ton.

The two chief contributors to the expedition were Henry D. Whiton, who gave the *Arcturus*, and Harrison Williams who provided three-fourths of the entire cost. Other generous contributors were Marshall Field, Clarence Dillon, Vincent Astor, The American Museum, George F. Baker, Jr., Arthur T. Newbold, Thomas S. Yates and Junius S. Morgan. Other gifts to be recorded are a sounding machine from William H. Trotter; Sets of Oceanographic books from Frederic C. Wolcott; motion picture negatives from George Eastman; Flashlights and batteries from the National

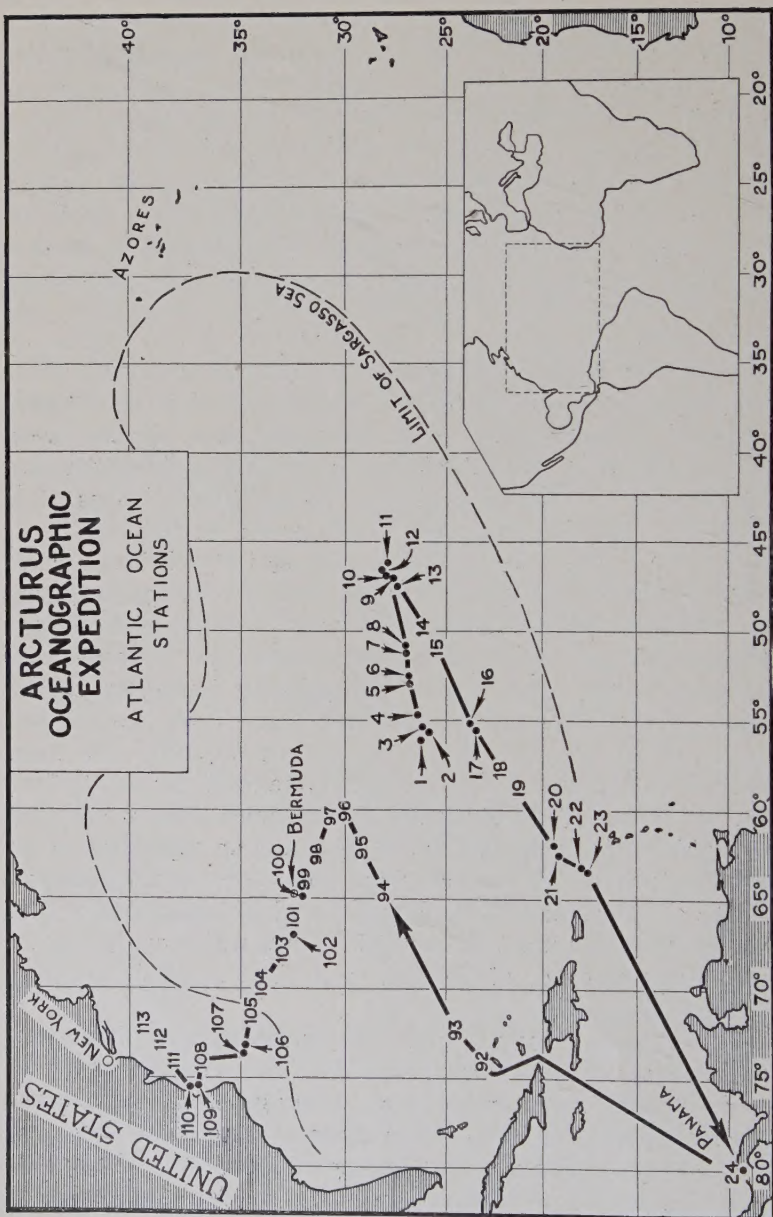


Plate A. Atlantic Ocean Stations. Arcturus Oceanographic Expedition.  
From a drawing by John Tee-Van.



Carbon Co.; a powerful radio set from the Stromberg-Carlson Mfg. Co. and the launch *Pawnee* from Harry Payne Bingham. To Earnest Lester Jones, Chief of the Coast and Geodetic Survey, I am obliged for a host of kindnesses and the loan of valuable instruments, and to the U. S. Fisheries Bureau for the *Albatross* launch and much valuable gear.

The entire responsibility for the sea-going condition of the *Arcturus*, her complete overhauling and the supervision of the building of laboratories, dark-rooms, refrigerators, and oceanographic apparatus was assumed by Mr. J. R. Gordon and the naval architect, Edwin C. Bennett. Capt. Yates acted throughout for Mr. Williams, and it is to the whole-hearted enthusiasm and interest of these gentlemen that the smoothness of operation and general success of the mechanical basis of the expedition was due.

For Captain Howes and First Mate McLaughlin I have nothing but single-minded praise. No more willing, patient and capable seamen ever existed.

The scientific staff was of my own choosing, each of the seventeen members having a definite field of work, which they filled to the full extent of their ability. Without their loyalty, constant enthusiasm and coöperation, nothing of success could have been achieved.

The scientific working personnel was as follows: William Beebe, Director; W. K. Gregory, Associate in Vertebrates; L. Segal, Associate in Special Problems; C. J. Fish, Associate in Diatoms and Crustacea; John Tee-Van, General Assistant; William H. Merriam, Assistant in Field Work; Isabel Cooper and Helen Tee-van, Scientific artists; Ruth Rose, Historian and Technician; Marie Fish, Assistant in Larval Fish; Elizabeth Trotter, Assistant in Fish Problems; Dwight Franklin, Assistant in Fish Preparation; Jay F. W. Pierson, Assistant in Macroplankton; Don Dickerman, Assistant artist; E. B. Schoedsack, Assistant in Photography; Serge Chetyrkin, Preparator; D. W. Cady, Surgeon.



Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Meters			
		Lat. North	Long. West										
9	T1	27° 42'	46° 59'	1040 m. ESE of Bermuda	2529	Feb. 28	8.35 A.M.	30	0	0			
	V1						2.47 P.M.	24	66-0	122-0			
	T2						4.28 P.M.	1 53	273	500			
	T3								546	1000			
	T4								1093	2000			
	T5								1367	2500			
10	T6						1640		3000				
	T1	27° 58'	46° 54'	1040 m. ESE of Bermuda		Mar. 1	8.50 A.M.	2 10	0	0			
	T2						8.50 A.M.	2 10	0	0			
	T3						8.00 P.M.	1	0	0			
	T4						8.00 P.M.	1	0	0			
	D1	27° 53'	46° 24'				12.11 P.M.	4	2491	4557			
11	T1						{ 1070 m. ESE of Bermuda 1070 m. SW of Azores 1115 m. NE of Sombbrero		Mar. 2	7.30 P.M.	1 30	0	0
	T2			7.30 P.M.	1 30	0				0			
	T3			7.30 P.M.	1 30	0				0			
	V1	27° 58'	46° 52'	8.59 A.M.	109-0	200-0							
	V2			9.22 A.M.	273-0	500-0							
	VC1				37	546-273				1000-500			
12	VC2			1030 m. ESE of Bermuda	2180	Mar. 3		14	1093-546	2000-1000			
	VC3							57	1640-1093	3000-2000			
	T1	27° 44'	47° 10'				7.30 P.M.	1 20	0	0			
	T2						7.30 P.M.	1 20	0	0			
	T3												
	13	T1	26° 10'				50° 00'	890 m. NE of Sombbrero		Mar. 4	7.45 P.M.	1	0
T2				7.45 P.M.	1	0	0						
T3				7.45 P.M.	1	0	0						
PT1		{ 12 noon 25° 29'	51° 00'	830 m. NE of Sombbrero	2790	Mar. 5	10.20 A.M.				3 3	500	909
PT2							10.20 A.M.				3 15	250	450
PT3							6.43 P.M.				1 12	250	450
T1	6.45 P.M.						1 15	0					
14	T2			570 m. NE of Sombbrero		Mar. 7	9.30 A.M.	4	250	450			
	T3												
	PT1	23° 42'	55° 09'				8.00 P.M.	1	0	0			
	PT2	23° 25'	55° 31'				8.00 P.M.	1	0	0			
	T1	22° 13'	57° 44'				8.00 P.M.	1	0	0			
	T2						8.00 P.M.	1	0	0			
15	T1			380 m. NE of Sombbrero		Mar. 8							
	T2												
	T3												
	PT1												
	PT2												
	PT3												
16	T1			570 m. NE of Sombbrero		Mar. 7							
	T2												
	T3												
	PT1												
	PT2												
	PT3												
17	T1			570 m. NE of Sombbrero		Mar. 7							
	T2												
	T3												
	PT1												
	PT2												
	PT3												
18	T1			570 m. NE of Sombbrero		Mar. 8							
	T2												
	T3												
	PT1												
	PT2												
	PT3												



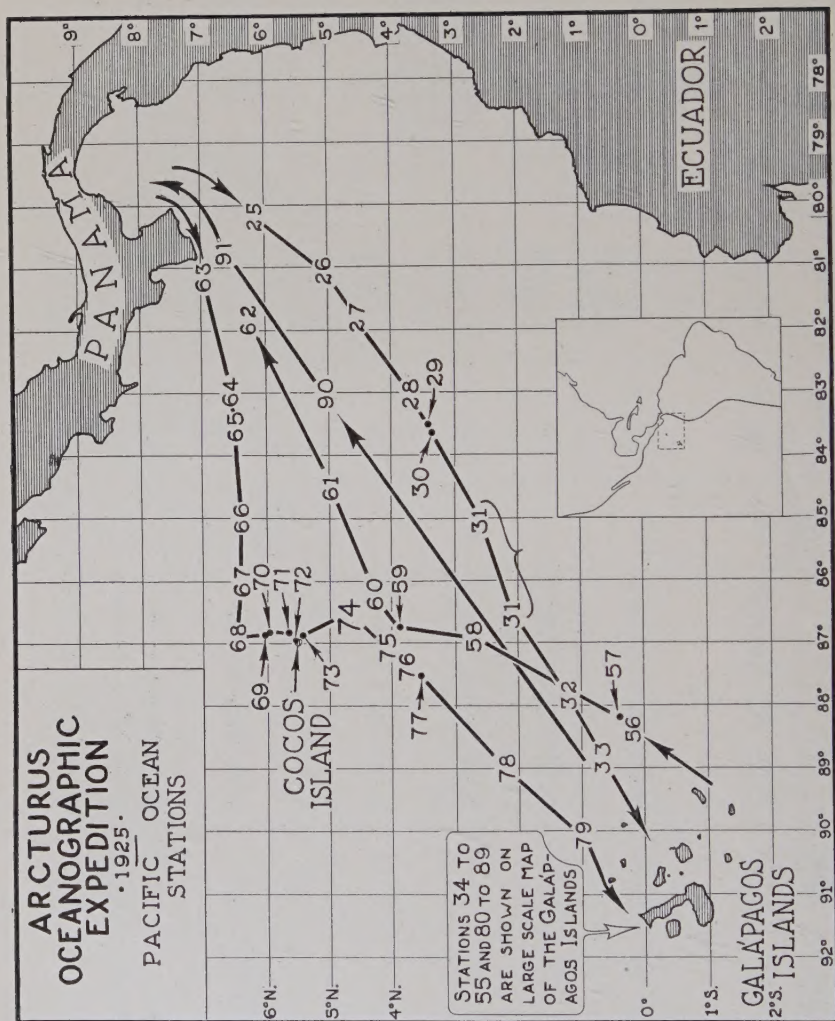


Plate B. Pacific Ocean Stations. Arcturus Oceanographic Expedition.  
From a drawing by John Tee-Van.



Station Number	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Meres
	Lat. North	Long. West							
19	21° 10'	58° 46'	320 m. NE of Sombbrero	3146	Mar. 9	10.00 A.M. 2.30 P.M. 7.00 P.M.	4 2 2	250 250 0	450 450
20	19° 21'	61° 57'	100 m. NE of Sombbrero		Mar. 12	2.52 P.M.	8	109-0	200-0
21	10° 07'	62° 31'	65 m. NE of Sombbrero		Mar. 12	8.00 P.M. 8.00 P.M. 8.00 P.M.	1 1 1	0 0 0	0 0 0
22	17° 56'	63° 12'	8 m. S of St. Martin	200	Mar. 13	7.00 P.M.			
23	17° 39'	63° 17'	2 m. SW of Saba		Mar. 14	8.30 A.M. 10.00 A.M. 1.30 P.M. 3.00 P.M.	15 30 1 10	45 250 120 120	82 450 218 218
23a	17° 39'	63° 16'	2 m. SW of Saba		Mar. 15	1.27 P.M. 2.05 P.M. 3.04 P.M. 3.40 P.M. 4.12 P.M.	10 10 10 9 10	7 54.6 54.6 70 71	12.7 100 100 127 130
23b	17° 39'	63° 16'	2 m. SW of Saba	478	Mar. 15	9.15 A.M. 10.58 A.M.	10 29	656 820	1200 1500
24	9° 22.5'	79° 56'	Colon, Panama		Mar. 21-27				
25	6° 10'	80° 11'	65 m. S of Cape Malo		Mar. 29	7.00 P.M. 7.00 P.M. 7.00 P.M.	1 1 1	0 0 0	0 0 0
26	5° 03'	81° 18'	120 m. S of Mariato Point	2070	Mar. 30	9.13 A.M. 7.30 A.M. 9.50 A.M. 9.50 A.M. 9.13 A.M. 9.20 A.M.	1 1 20 20 1 40	273 0 0 136 19	500 0 0 250 35
27	4° 30'	81° 49'	165 m. SW of Mariato Point		Mar. 30	7.00 P.M.	20	0	0
28	T1 T2		260 m. SE of Cocos	1805	Mar. 31	5.15 A.M. 5.15 A.M.	15 15	0 0	0 0

Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
29	T3 OT1						8.55 A.M. 9.15 A.M.	15 1	0 273	0 500
	T1 PT1 PT1	3° 23'	83° 33'	240 m. SE of Cocos		Mar. 31	3.50 P.M. 3.30 P.M.	30 30	136 273	250 500
	T1 T2	3° 23'	83° 34'			Mar. 31	8.00 P.M. 8.00 P.M.	20 20	0 0	0 0
31	PT1 PT2	2° 36'	85° 01'	215 m. SSE of Cocos	1826	Apr. 1	8.45 A.M. 9.15 A.M.	15 20	0 13.6	0 25
	PT3 PT4 T1 OT1	2° 8' 2° 4'	86° 17' 86° 31'			Apr. 2	9.00 A.M. 11.00 A.M. 11.00 A.M. 4.00 P.M.	1 2 2 20	0 273 136 0	0 500 250 0
	T1 T2	1° 14'	87° 50'	140 m. N.E. of Tower	1462	Apr. 3	5.40 A.M. 5.40 A.M.	20 20	0 0	0 0
33	T1 PT1 T2 T3	0° 40'	88° 51'	70 m. NE of Tower	1392	Apr. 3	2.00 P.M. 2.27 P.M. 8.00 P.M. 8.00 P.M.	1 1 25 25	0 700 0 0	0 1274 0 0
	T1 T2	0° 00'	90° 00'	20 m. South of Tower	559	Apr. 4	5.30 A.M. 5.30 A.M.	30 30	0 0	0 0
				22 m. NE of Indefatigable	710	Apr. 4				
35				1 m. W of Seymour		Apr. 4-6	9.30 A.M. 4.00 P.M.	30 30	0 0	0 0
37	T1 T2	0° 27'	90° 19'	Darwin Bay, Tower		Apr. 7	7.30 P.M. 7.30 P.M.	30 30	0 0	0 0
	T3					" 8	11.00 A.M.	30	0	0
	T4					" 9	7.00 P.M.	30	0	0
	T5					" 10	7.30 P.M.	30	0	0
	T6					" 11	7.30 P.M.	30	0	0
	T7					" 12	7.30 P.M.	30	0	0
	T8					" 13	7.30 P.M.	30	0	0
	T9					" 14	7.30 P.M.	30	0	0
						" 15	7.30 P.M.	30	0	0



Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
38	PT1 PT2 T1 T2	0° 17'	90° 02'	7 m. W of Tower	448	Apr. 11	12.13 P.M. 8.23 P.M. 6.45 P.M. 6.45 P.M.	62 1 35 35	300 500 0 0	545 909 0 0
39	T1 T2 T3 PT1 T1 T2 T3 PT2	0° 05'	91° 11.5'	1 m. off NE coast of Albemarle	1039	Apr. 12  Apr. 13	7.30 P.M. 7.30 P.M. 8.16 P.M. 10.48 A.M. 10.48 A.M. 7.15 A.M. 7.15 A.M. 2.57 A.M.	30 30 30 1 1 30 30 57	0 0 0 500 250 0 0 600	0 0 0 909 450 0 0 1090
40	T1 D1	0° 14'	91° 18'	5 m. N of Albemarle	1647	Apr. 14	4.20 A.M. 11.11 A.M.	30 1 36		
41	T1 T2 T3	0° 31'	91° 00'	13 m. W of Abingdon	1409	Apr. 14	6.45 P.M. 6.45 P.M. 7.55 P.M.	30 30 10	0 0 0	0 0 0
42	T1 T2	0° 32'	91° 06'	20 m. W of Abingdon		Apr. 15	4.50 A.M. 4.50 A.M.	25 25	0 0	0 0
43	D1 PT1	0° 34'	90° 47'	½ m. W of Abingdon	431	Apr. 15	10.48 A.M.	32	225	
44	PT1	0° 27'	90° 42'	Midway between Abingdon & Bindloe	548	Apr. 15	3.10 P.M.	50	250	450
45	OT1 T1 T2 T3	0° 20'	90° 10'	12 m. W of Tower	493	Apr. 15	9.35 P.M. 9.30 P.M. 9.30 P.M. 9.35 P.M.	33 30 30 30	205 0 0 200	372 0 0 363
46				Darwin Bay, Tower						
47	T1	0° 03'	89° 50'	23 m. S of Tower		Apr. 20	9.30 P.M.	20	0	0
48	PT1 T1 T2 T3	1° 20' (S)	89° 33'	12 m. E of Hood	174	Apr. 21	4.18 P.M. 4.10 P.M. 4.18 P.M. 4.30 P.M.	27 25 27 15	50 0 50 0	90 0 90 0
49	PT1			10 m. SE of Hood	401	Apr. 21	7.40 P.M.	55	200	363





Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
50	T1	2° 00' (S)	89° 30'	34 m. SE of Hood	1820	Apr. 22	7.40 P.M.	55	200	363
	T2						8.10 P.M.	20	0	0
	T1						12.40 P.M.	1	0	0
	T2						12.40 P.M.	35	400	727
	T3						12.40 P.M.	1	800	1454
51	OT1	2° 33' (S)	89° 44'	67 m. S of Hood	1835	Apr. 23	12.40 P.M.	1	800	1454
	T4						12.40 P.M.	1	1200	2181
	P1						12.40 P.M.	1	1200	2181
	T5						7.00 P.M.	30	0	0
	PT1						9.00 A.M.	2	273	500
52	T1	2° 00' (S)	89° 48'	34 m. S of Hood	1733	Apr. 23	9.00 A.M.	2	54	100
	T2						9.00 A.M.	2	164	300
	T3						9.00 A.M.	2	273	500
	PT2						2.00 P.M.	1	800	1454
	T4						2.30 P.M.	40	2.7	5
53	T1	1° 51' (S)	89° 50'	25 m. S of Hood	1733	Apr. 24	6.30 P.M.	30	0	0
	T2						7.30 P.M.	30	0	0
	T3						7.30 P.M.	30	0	0
	T4						9.00 P.M.	30	0	0
	D1						9.40 A.M.	35	1733	3156
54	T1	1° 22' (S)	89° 39'	Gardner Bay, Hood	1733	Apr. 25	9.40 A.M.	35	1093	2000
	T2						9.40 A.M.	35	800	1463
	T3						7.20 P.M.	25	0	0
	D2						7.00 A.M.	1	1733	3156
	T1						7.20 P.M.	25	0	0
55	T2	1° 16' (S)	89° 28'	13 m. NE of Hood	1388	Apr. 26	7.30 P.M.	20	0	0
	T3						7.30 P.M.	20	0	0
56	T1	0° 10'	88° 22'	98 m. E of Tower	1388	Apr. 27	8.00 P.M.	20	0	0
	T1						3.04 P.M.	44	400	727
57	T1	0° 22'	88° 11'	105 m. E of Tower	1388	Apr. 29	3.04 P.M.	44	800	1463
	T2						8.00 P.M.	30	0	0
58	T1	2° 42'	86° 56'	170 m. S of Cocos	1388	Apr. 30	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0

Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul		Depth in Fathoms	Depth in Metres
		Lat. North	Long. West					H	M		
59	T1	3° 52'	86° 43'	105 m. S of Cocos	796	May 1	5.15 A.M.	30	0	0	0
	T2						8.20 A.M.	1 45	100	181	181
	T3						9.20 A.M.	1 45	300	545	545
	T4						9.20 A.M.	1 45	500	909	909
	T5						9.20 A.M.	1 45	600	1090	1090
	PT1						9.20 A.M.	1 45	600	1090	1090
	T6						9.20 A.M.	1 20	0	0	0
	T7						2.10 P.M.	1 15	150	272	272
	T8						2.13 P.M.	1 15	300	545	545
	T9						2.13 P.M.	1 15	500	909	909
	T10						2.13 P.M.	1 15	600	1090	1090
	PT2						2.13 P.M.	1 15	600	1090	1090
60				90 m. SSE of Cocos							
61	T1	4° 56'	84° 35'	150 m. ESE of Cocos	1690.7	May 2	2.10 P.M.	50	0	0	0
	T2						1.50 P.M.	1 40	150	272	272
	T3						1.50 P.M.	1 40	300	545	545
	T4						1.50 P.M.	1 40	500	909	909
	T5						1.50 P.M.	1 40	600	1090	1090
	PT1						1.50 P.M.	1 40	600	1090	1090
62	T1	6° 16'	80° 48'	60 m. SW of Mariato Point		May 3	8.00 P.M.	30	0	0	0
63	T1	6° 58'	81° 08'	20 m. W of Mariato Point		May 11	8.00 P.M.	30	0	0	0
	T2						8.00 P.M.	30	0	0	0
	OT1						8.00 P.M.	30	0	0	0
64		6° 34'	83° 00'	250 m. E of Cocos	1036	May 12					
65	T1	6° 30'	83° 33'	215 m. E of Cocos		May 12	6.00 P.M.	15	0	0	0
	T2						6.15 P.M.	15	0	0	0
	OT1						8.30 P.M.	30	0	0	0
	T3						8.00 P.M.	30	0	0	0
	T4						9.00 P.M.	30	0	0	0
66	T1	6° 24'	85° 00'	130 m. NE of Cocos	1125	May 13	10.10 P.M.	3	300	545	545
	T2						10.10 P.M.	3	500	909	909
	T3						10.10 P.M.	3	600	1090	1090
	PT1						10.10 P.M.	3	600	1090	1090
67	T1	6° 24'	86° 00'	78 m. NE of Cocos		May 13	8.05 P.M.	30	0	0	0
68	T1	6° 27'	86° 54'	50 m. N of Cocos	1676	May 14	5.00 A.M.	30	300	545	545



Station Number	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
69	T2	5° 56'	86° 52'	20 m. N of Cocos	1334	May 14	9.12 A.M.	1 33	400	727
	T3						9.12 A.M.	1 33	500	909
	T4	5° 58'	86° 50'		1251	May 14	6.45 P.M.	30	0	0
	T5						7.55 P.M.	35	0	0
	PT1				335	May 15				
70	T1	5° 38'	86° 48'	10 m. NE of Cocos						
71	T2	5° 32'	86° 59'	Chatham Bay, Cocos		May 14-24				
72		5° 28'	86° 54'	6 m. S of Cocos		May 24	8.00 P.M.	30	0	0
73	T1									
74	T2	4° 50'	87° 00'	60 m. S of Cocos	514-900	May 25	9.30 A.M.	1 30	0	0
	T3						9.15 A.M.	1 33	150	272
	T4						9.15 A.M.	1 30	300	545
	T5						9.15 A.M.	1 30	500	909
	PT1						9.15 A.M.	1 33	600	1090
	T6						9.15 A.M.	1 33	600	1090
	T7						2.00 P.M.	1 47	350	636
	T8						2.00 P.M.	1 47	450	818
	T9						2.00 P.M.	1 47	500	909
	PT2						2.00 P.M.	1 47	600	1090
	T10						7.30 P.M.	1 47	600	1090
	V1					May 26		30	0	0
	V2								546-0	1000-0
	V3								273-0	500-0
	VC2								164-0	300-0
	V4								382-273	700-500
	VC3								273-164	500-300
	V5								273-0	500-0
	VC4								273-0	500-0
	VC5								273-164	500-300
	V6								164-0	300-0
	VC6								546-382	1000-700
	V7								382-0	700-0
	VC7								710-546	1300-1000
	T11						7.15 P.M.	45	546-0	1000-0

Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
	T12					May 27	7.15 P.M.	45	0	0
	T13						9.45 A.M.		0	0
	T14						9.08 A.M.	1 37	300	545
	T15						9.08 A.M.	1 37	450	818
	T16						9.08 A.M.	1 37	550	1000
	T17						9.08 A.M.	1 37	620	1090
	T18						9.08 A.M.	1 37	620	1127
	T19						2.19 P.M.	1 26	450	545
	T20						2.19 P.M.	1 26	550	818
	T21						2.19 P.M.	1 26	600	1000
	T22						2.19 P.M.	1 26	600	1090
	T23						7.30 P.M.	30	0	0
	T24						8.00 P.M.	30	0	0
	T25						8.30 P.M.	30	0	0
	OT1					May 28	9.47 A.M.	58	900	1636
	T26						7.30 P.M.	45	0	0
	OT2					May 29	9.00 A.M.	1 40	750	1363
	OT3						2.11 P.M.	1 29	833	1514
	T27						2.11 P.M.	1 29	500	909
	OT4					May 30	9.06 A.M.	1 31	625	1145
	OT5						2.03 P.M.	1 37	625	1145
	T28						7.00 P.M.	30	0	0
	T29						8.00 P.M.	30	0	0
	OT6					May 31	lost	27	844	1534
	D1						7.33 A.M.	30	0	0
	T30						2.00 P.M.	30	0	0
	T31						3.00 P.M.	30	0	0
	T32						4.00 P.M.	30	0	0
	T33						5.00 P.M.	30	0	0
	T34						7.00 P.M.	30	0	0
	T35						7.00 P.M.	30	0	0
	T36						8.00 P.M.	30	0	0
	T37						9.00 P.M.	30	0	0
	T38						10.00 P.M.	30	0	0
	T39						11.00 P.M.	30	0	0
	T40					June 1	12.00 A.M.	30	0	0
	T41						1.00 A.M.	30	0	0

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cont.



Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms.	Date 1925	Time	Duration of Haul H. M.	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
	T42						2.00 A.M.	30	0	0
	T43						3.00 A.M.	30	0	0
	T44						4.00 A.M.	30	0	0
	T45						5.00 A.M.	30	0	0
	T46						6.00 A.M.	30	0	0
	T47						7.00 A.M.	30	0	0
	T48						8.00 A.M.	30	0	0
	D2						9.00 A.M.	30	787	1430
	T49						10.00 A.M.	30	0	0
	T50						11.00 A.M.	30	0	0
	T51						12.00 P.M.	30	0	0
	T52						1.00 P.M.	30	0	0
	T53						2.00 P.M.	30	0	0
	T54						3.00 P.M.	30	0	0
	T55						4.00 P.M.	30	0	0
	T56						5.00 P.M.	30	0	0
	T57						6.00 P.M.	30	0	0
	T58						7.00 P.M.	15	0	0
	T59						8.00 P.M.	15	0	0
	T60						9.00 P.M.	15	0	0
	T61						10.00 P.M.	15	0	0
	T62						11.00 P.M.	15	0	0
	T63						12.00 P.M.	15	0	0
	T64						1.00 P.M.	15	0	0
	T65						2.00 P.M.	15	0	0
	T66						3.00 P.M.	15	0	0
	T67						4.00 P.M.	15	0	0
	OT7					June 2	2.30 P.M.	749	1361	1361
	T68						3.00 P.M.	300	545	545
	T69						4.00 P.M.	300	727	727
	T70						5.00 P.M.	500	909	909
	T71						6.00 P.M.	600	1090	1090
	PT5						7.00 P.M.	1	0	0
	T72						8.00 P.M.	1	0	0
	T73					June 3	9.32 A.M.	400	727	727
	T74						10.00 A.M.	400	727	727
	T75						11.00 A.M.	500	909	909
	T76						12.00 P.M.	600	1090	1090
	T77						1.00 P.M.	700	1274	1274
	T78						2.00 P.M.	800	1456	1456
	PT6					June 4	3.00 P.M.	1	765	1390
	D3						4.00 P.M.	1	765	1390
75		4° 03'	87° 05'	90 m. S of Cocos						

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing in Fathoms	Date 1925	Time	Dura-tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
76		3° 45'	87° 22'	110 m. S of Cocos		June 4				
77	T1 T2	3° 34'	87° 33'	125 m. S of Cocos	1205	June 4	8.00 P.M.	1	0	0
78	T1 T2	2° 12'	89° 01'	125 m. NE of Tower	1322	June 5	8.00 P.M.	1	0	0
79		1° 00'	90° 04'	40 m. N of Tower	1249	June 6				
80	T1 T2 T3	00° 44'	90° 45'	7 m. N of Abingdon		June 6	8.00 P.M.	30	0	0
81		00° 10' (S)	91° 31'	Banks Bay, Albemarle	118	June 7				
82		00° 12' (S)	91° 28'	Banks Bay, Albemarle	953	June 7				
83	T1	00° 16'	91° 23'	Tagus Cove, Albemarle	627	June 7-9	1.45 P.M.	2	300	545
84	T2 T3 T4 PT1 T5 T6	0° 17' (S)	91° 34'	1 m. N of Narborough		June 9	1.45 P.M. 1.45 P.M. 1.45 P.M. 1.45 P.M. 7.30 P.M. 8.00 P.M.	2 2 2 2 2 1	400 450 500 500 0 0	727 818 909 909 0 0
	T7						9.11 P.M.	1	300	545
	T8						9.11 P.M.	1	400	727
	T9						9.11 P.M.	1	14	818
	T10						9.11 P.M.	1	14	450
	PT2						9.11 P.M.	1	300	545
	T11						1.55 P.M.	1	14	909
	T12						1.55 P.M.	1	300	545
	T13						1.55 P.M.	1	400	727
	T14						1.55 P.M.	1	45	818
	PT3						1.55 P.M.	1	45	909
	T15						7.00 P.M.	1	500	909
	T16						7.00 P.M.	1	0	0
	T17						8.00 P.M.	1	0	0
	T18						8.00 P.M.	1	0	0
	T19					June 11	2.06 P.M.	32	400	828
	T20						2.06 P.M.	32	500	909
	T21						2.06 P.M.	32	600	1090
	T22						2.06 P.M.	32	700	1274
	PT4						2.06 P.M.	1	700	1274

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing in Fathoms	Date 1925	Time	Dura-tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
85	T1	0° 25'	91° 42'	3 m. W of Narborough	1900	June 11	8.00 P.M.	1	0	0
86	T1	0° 42'	91° 47'	16 m. SW of Narborough		June 12	9.39 A.M.	51	400	727
	T2						9.39 A.M.	51	500	909
	T3						9.39 A.M.	51	600	1090
	T4						9.39 A.M.	51	800	1454
	T5						9.39 A.M.	51	1000	1818
	PT1						9.39 A.M.	51	1000	1818
	T6						2.15 P.M.	1	0	0
	T7						2.06 P.M.	1	15	727
	T8						2.06 P.M.	1	18	909
	T9						2.06 P.M.	1	18	1090
	T10						2.06 P.M.	1	18	1454
87	T11	0° 00'	91° 53'	21 m. NW of Narborough	1720	June 13	2.06 P.M.	1	1000	1818
	OT1						2.06 P.M.	1	18	1818
	T1						9.11 A.M.	1	100	181
	T2						9.11 A.M.	1	49	727
	T3						9.11 A.M.	1	49	818
	T4						9.11 A.M.	1	49	909
	T5						9.11 A.M.	1	49	1090
	T6						9.11 A.M.	1	49	1274
	PT1						9.11 A.M.	1	49	1274
	T1						8.10 P.M.	40	0	0
	T2						9.00 P.M.	30	0	0
88	T3	0° 11'	91° 21'	3 m. N of Albemarle		June 13	9.35 P.M.	5	0	0
	T4						9.45 P.M.	5	0	0
89	T1	0° 02'	91° 01'	13 m. E of Albemarle		June 14	8.00 P.M.	1	0	0
90	T1	5° 04'	83° 04'	125 m. SE of Cocos		June 18	8.00 P.M.	30	0	0
91	T1	6° 40'	80° 49'	25 m. S of Mariato Point		June 19	8.00 P.M.	30	0	0
92	T1	22° 59'	74° 17'	Atlantic Ocean		July 3	8.00 P.M.	30	0	0
	T2	22° 59'	74° 17'	60 m. S of San Salvador			8.00 P.M.	30	0	0
93	T1	24° 31'	72° 24'	120 m. E of San Salva-		July 4	8.00 P.M.	30	0	0
	T2	24° 31'	72° 24'	dor			8.00 P.M.	30	0	0
	T3	24° 31'	72° 24'				8.00 P.M.	30	0	0



Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
94	T1	28° 10'	64° 35'	250 m. S of Bermuda		July 9	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0
95	T1	29° 13'	62° 00'	270 m. SE of Bermuda		July 10	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	6 ft.	0
	T3						8.00 P.M.	30	0	0
96	T1	30° 00'	60° 00'	280 m. SE of Bermuda	2875	July 11	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0
	V1	30° 01'	60° 03'			July 12	8.00 P.M.	28	546-0	1000-0
	T4						10.36 A.M.	28	150	272
	T5						10.36 A.M.	28	300	545
	T6						10.36 A.M.	28	500	909
	T7						10.36 A.M.	28	600	1090
97	T8						10.36 A.M.	28	1200	2181
	PT1						10.36 A.M.	28	1200	2181
	V1	30° 49'	61° 21'	190 m. SE of Bermuda		July 13	8.56 A.M.	24	820-0	1500-0
	V2						10.11 A.M.	28	546-0	1000-0
	VC1						11.20 A.M.	23	273-164	500-300
	VC2							23	478-324	893-593
	VC3						2.20 P.M.	30	546-437	1000-800
	VC4								437-273	800-500
98	VC5								820-546	1500-1000
	T1						8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0
	V1	31° 22'	62° 35'	125 m. SE of Bermuda	2587	July 14	10.44 A.M.	51	820-546	1500-1000
99	V2						11.44 A.M.	11	164-0	300-0
	V3						12.52 P.M.		1093-820	2000-1500
	V4						3.30 P.M.		273-0	500-0
	V5						4.40 P.M.		437-0	800-0
	V5								546-0	1000-0
100	T1	31° 57'	64° 00'	45 m. SE of Bermuda		July 15			820-0	1500-0
	T2	32° 00'	65° 00'	10 m. S of Bermuda		July 15	8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul		Depth in Fathoms	Depth in Metres
		Lat. North	Long. West					H	M		
101	T4					July 16	8.45 P.M.	1	45	0	0
	D1						8.35 A.M.		6	29	54
	D2						9.28 A.M.		12	29	53
	T3						11.49 A.M.	2	13	300	545
	T6						11.49 A.M.	2	13	400	727
	T7						11.49 A.M.	2	13	500	909
	T11						11.49 A.M.	2	13	500	909
	T8						8.00 P.M.		30	0	0
	T9						8.00 P.M.		30	0	0
	T10						8.02 P.M.	1	1	200	363
	T11						8.02 P.M.	1	1	300	545
	T12						10.07 A.M.	3	1	0	0
	T13					July 17	10.07 A.M.	3	1	100	181
	T14						10.07 A.M.	3	1	200	363
	T15						10.07 A.M.	3	1	300	545
	T16						10.07 A.M.	3	1	400	727
102	T17						10.07 A.M.	3	1	500	909
	T18						10.07 A.M.	3	1	600	1090
	T19						10.07 A.M.	3	1	700	1274
	T20						10.07 A.M.	3	1	800	1454
103		32° 26'	66° 23'	75 m. W of Bermuda	2624	July 18					
104	T1	32° 48'	67° 09'	120 m. W of Bermuda		July 18	8.00 P.M.	30		0	0
	T2						8.00 P.M.	30		0	0
105		32° 00'	68° 00'	160 m. W of Bermuda		July 19					
		33° 58'	70° 21'	275 m. NW of Bermuda		July 20					
	T1	34° 27'	71° 36'	210 m. ESE of Cape		July 20					
	T2			Hatteras	2803	July 20	1.48 P.M.	1	48	0	0
	T3						1.48 P.M.	1	48	250	450
	T4						1.48 P.M.	1	48	500	909
	T5						1.48 P.M.	1	48	600	1090
	T6						1.48 P.M.	1	48	700	1274
106		34° 44'	73° 20'	115 m. SE of Cape Hat- teras		July 21					
107		34° 47'	73° 41'	100 m. SE of Cape Hat- teras		July 21					
	T1						1.48 P.M.	1	52	0	0
	T2						1.48 P.M.	1	52	250	450
	T3						1.48 P.M.	1	52	500	909
	T4						1.48 P.M.	1	52	600	1090
	T5						1.48 P.M.	1	52	700	1274
	T6						1.48 P.M.	1	52	800	1454

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
108	T1	36° 55'	74° 12'	90 m. E of Chesapeake Bay	1091	July 22	11.12 A.M.	1	0	0
	T2						11.12 A.M.	1	300	545
	T3						11.12 A.M.	1	400	727
	T4						11.12 A.M.	1	500	900
	T5						11.12 A.M.	1	600	1090
	T6						11.12 A.M.	1	700	1274
109	D1	36° 56'	75° 28'	30 m. E of Chesapeake Bay		July 23	8.45 A.M.	20	19	36
	D2						8.45 A.M.	20	32	60
110	T1	30° 16'	74° 58'	45 m. E of Chesapeake Bay		July 23	8.00 P.M.	30	0	0
111	PT1	38° 00'	74° 02'			July 24	9.07 A.M.	20	60	109
	D1						11.46 A.M.	54	0	0
112	D2								382	694
	T1	38° 31'	73° 12'			July 24	8.00 P.M.	30	0	0
113	D1	39° 15'	72° 00'	100 m. SE of Delaware Bay 125 m. SE of City Hall, N. Y. City	950-1200	July 25	8.52 A.M.	31	633	1150
	T1						11.32 A.M.	27	300	545
	T2						11.32 A.M.	1	27	350
	T3						11.32 A.M.	1	27	400
	T4						11.32 A.M.	1	27	450
	T5						11.32 A.M.	1	27	500
	T6						10.00 P.M.	30	0	0
	T7						12.00 P.M.	30	0	0
	T8					July 26	1.00 A.M.	30	0	0
	T9						2.00 A.M.	30	0	0
	T10						3.00 A.M.	30	0	0
	T11						4.00 A.M.	30	0	0
	T12						5.00 A.M.	30	0	0
	T13						6.00 A.M.	30	0	0
	T14						7.00 A.M.	30	0	0
	T15						8.00 A.M.	30	0	0
	T16						9.00 A.M.	30	0	0
	T17						10.00 A.M.	30	0	0
	T18						11.00 A.M.	30	0	0
	T19						12.00 P.M.	30	0	0
	T20						1.00 P.M.	30	0	0
	T21						2.00 P.M.	30	0	0
	T22						3.00 P.M.	30	0	0
	T23							30	0	0







Depths Metres	Sta. 50		Sta. 51		Sta. 56		Sta. 59		Sta. 66		Sta. 68		Sta. 74		Sta. 84	
	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.
0	0	25.9	-0.05	23.45	0	27.2	0	27.5	0	28.5	0	28	0	27.5	0	22.1
25	0	—	—	22.1	0	23.2	0	27.9	0	26.5	0	28.65	0	27.1	0	20.6
50	-0.05	22.45	0	21.47	-0.15	18.75	+0.05	22.55	-0.15	18.3	-0.1	23.67	-0.1	19.97	—	22.0
75	—	17.7	-0.05	—	-0.1	—	+0.05	—	-0.15	—	-0.05	—	-0.15	—	—	—
100	-0.15	15.45	-0.05	20.87	-0.1	16.25	-0.2	14.3	-0.2	13.97	-0.25	15.57	-0.25	14.57	-0.05	18.75
150	-0.15	—	0	—	-0.15	—	-0.2	—	-0.2	—	-0.2	—	-0.2	—	-0.05	—
250	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
300	-0.2	11.6	-0.2	11.9	-0.2	12.22	-0.25	11.3	-0.2	11.27	-0.25	11.20	-0.2	11.62	-0.2	11.8
450	-0.2	—	-0.2	—	-0.25	—	-0.25	—	-0.25	—	-0.3	—	-0.2	—	-0.2	—
500	-0.25	8.32	-0.3	7.9	-0.25	8.25	-0.25	8.1	-0.25	7.92	-0.3	8.3	-0.25	8.35	-0.25	7.95
1000	-0.4	4.8	-0.3	—	-0.25	—	-0.25	—	-0.2	—	-0.3	—	-0.25	—	-0.25	—
1500	-0.5	3.17	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2000	-0.5	2.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2500	-0.45	1.95	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3000	-0.55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3000	-0.45	1.72	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3000	-0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Note: C. = Correction.

C.T. = Corrected Temperature—or average of 2 corrected readings.

\* 2 sets thermometers taken at this depth: 1 = first set, 2 = second set.



IV. CHLORINE IN SEA WATER 0/00.  
 BY TITRATION WITH SILVER NITRATE  
 MADE BY JOHN B. WILSON, ASSOC. CHEMIST.  
*Bureau of Chemistry, U. S. Department of Agriculture*

Station No.	Surface	25M	50M	75M	100M	250M	300M	450M	500M	1000M	1500M	2000M	2500M	3000M
3.	20.46						19.36							
5.	20.46		19.48				20.11		19.92	19.57				
9.	20.46		20.52				20.70		20.26	19.74				
15.	20.35						20.26		19.97	19.46	19.28			
16.	20.35						20.05		19.51	19.26	19.40			
20.	20.00						19.37		19.22	19.22				
26.	18.92		19.45				19.31		19.21	19.17				
28.	18.70		19.21				19.31		19.23					
31.	18.75	18.74	18.74			19.29	19.27	19.33	19.34					
31B.	18.33		18.80			19.30	19.31	19.15	19.22					
33.			19.47											
35.	18.87	18.89	19.26			19.25	19.24							
38.	18.62	18.76	18.95				19.29		19.34	19.06	19.11	19.14		19.19
39.	18.66	18.69	19.16				19.34		19.20					
40.	18.46	17.79	19.17	19.45			19.36		19.04					
50.	18.78	19.12	19.28	19.44			19.37		19.10					
51.	18.91	19.45	19.54				19.32		19.18					
56.	18.77	18.96	19.44				19.25		19.16					
59.	17.76	18.17	18.86				19.25		19.10					
66.	17.79	18.73	19.16				19.22		19.18					
68.	18.24	18.61	19.06				20.23		20.08	20.03	19.39			
74.	17.88	18.25	19.98				20.13		20.13	19.59	19.36			
84.	19.32	19.32	19.56				20.14		20.14	20.15				
96.	20.14						20.14		20.06	19.58	19.39			
98.	20.20						20.11		20.18	19.55	19.41			
99.	20.19						20.14		20.16	19.46				
101.	20.10						20.14		19.76	19.41				
103.	19.97													
104.	20.00													
105.														

Land-locked Lagoon, Tower Island April 17, '25 Surface. Edge 22.14

Land-locked Lagoon, Tower Island April 17, '25 Surface. Center 25.40

Green Water, near Volcano, Albemarle Island 18.72

## V. RÉSUMÉ OF STATION AND HAUL RESULTS

As introduction to this preliminary survey of the plankton hauls of the *Arcturus* Expedition it may be worth while to quote a few paragraphs from one of my recently published popular accounts.\*

One dark, moonless evening I put out a silk surface net the mouth of which was round, and about a metre, or a yard, in diameter.

At the further end of the net a quart preserve jar was tied to receive and hold any small creatures which might be caught as the net was drawn slowly along the surface of the water. This was done at the speed of two knots, and, as I have said, was continued for the duration of one hour. When drawn in, the net sagged heavily and we poured out an overflowing mass of rich pink jelly into a white, shallow tray. This I weighed carefully, and then took, as exactly as possible, a one-hundred-and-fiftieth portion. I began to go over this, but soon became discouraged, and again divided it and set to work on one-sixth of the fraction on which I had first started. After many hours of eye-straining and counting under the microscope, I conservatively estimated my one-hundred-and-fiftieth part of the hour's plankton haul as follows:—

Feathery copepods—Candace-like.....	7,920
Bright blue copopods—Pontella-like.....	71,400
Other copopods—Calanus-like.....	139,320
Bivalve crustacea—Ostracods.....	4,920
Short-eyed shrimps.....	720
Siphonophores.....	14,400
Heliced snails.....	8,880
Purple <i>Ianthina</i> snails.....	13,440
Egg masses of snails.....	1,080
Free eggs, various.....	5,280
Clio-like pteropods.....	2,520
<i>Limacina</i> -like pteropods.....	240
<i>Cavolinia</i> -like pteropods.....	960

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Total of specimens.....271,080

If we multiply this by one hundred and fifty we get forty million, six hundred and sixty-two thousand individuals. Please remember that this is a very conservative estimate of only a few of the more easily counted groups in one small haul of an hour's duration, and the magnitude of the life of the sea will begin to dawn

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\* *The Arcturus Adventure*, pp. 199-200.

upon our minds. Twelve hours later—in full daylight—I repeated the haul as closely as possible and, instead of forty million, I captured about one thousand individuals of the corresponding groups.

The above figures give a more vivid meaning to the terms of relative occurrence, such as Abundant, Common and Many, which I have used in the following data. At my suggestion Dr. C. J. Fish kept a relatively accurate tally of the more easily recognizable groups of invertebrates of the plankton hauls, while I made a corresponding catalogue of the fish. For this purpose there was no attempt at specific identification, but the mere listing, in relative abundance, of the hundred-odd groups which leaped to the eye out of the quarts of millions of living organisms.

Reference to the Station data given in preceding pages will furnish the details of each haul, which can then be correlated with the present scheme. Future papers will present the exact identification of the various components.

As regards the symbols of relative abundance and rarity, after considerable thought, I have altered the scheme which I use in ecological work in the jungle,\* and have made a compromise with that of Dr. Fish. This is as follows:—

A—Exceedingly Abundant

C—Common; Abundant

M—Many

F—Few

R—Rare; Very Few

Applying this to the count made on page 27 I should adopt the following:

A—Calanus copepods	139,320
C—Pontella copepods	71,400
M—Siphonophores	14,400
F—Limacina pteropods	240

The sequence of groups under each haul is by relationship. In the case of unidentified species I have sometimes used arbitrary popular names which at least indicate the general group.

\* *Zoologica*, VI, No. 1, p. 43.



## VI. PACIFIC DEPTH PLANKTON HAULS

As closing nets were not used, there is, in the following tables, a small percentage of error, from the organisms, however few in number, which entered the nets during their comparatively rapid ascent to the surface. Rather than attempt to orient these I have chosen to include the sporadic occurrence of such obviously out-of-place organisms as *Halobates* at 300 and 600 fathoms and *Glaucus*, *Ianthina* and *Pontella* at 600 and 800 fathoms.

## 20—Fathom Plankton

Station and Haul	26 OT1
Siphonophores (transparent)	M
Jellyfish (transparent)	F
Sagitta (large)	A
Firola	M
Copepods	R
Eucalanus	R
Amphipods	M
Hyperid Amphipods	M
Lucifer	M
Macruran larvae	M
Bachyura megalops	1
Squilla larvae	C

## 50—Fathom Plankton

	48 T2
Hydromedusae	M
Sagitta (small)	C
Tomopteris	1
Creseis acicula	C
Cresia conica	C
Cavilina uncinata	2
Copepods (small pink)	C
Eucalanus	F
Hyperids (yellow)	F
Euphausiids (young)	F
Porcellana larvae	1
Halobates	1

## 100—Fathom Plankton

	59 T2	86 PT1	87 T1
Heliozoans (red)	M		
Radiolarians			M
Liriope			1
Tomopteris	1		
Gastropods	F		
Atlanta	2	1	
Cymbulia sibogae	1		
Copepods (small pink)	F		
Caligus (brown)			F
Hyperids (yellow)			1
Gnathophausia willemoesia		F	
Euphausiids	F		
Macrurans (red)		R	

## 150—Fathom Plankton

	26 T4	29 T1	31 T1	51 T2	59 T7	61 T2	74 T2
Siphonophores	M		M				C
Pleurobrachia (small)						F	
Beroe (pink)						F	
Annelids	1						R
Tomopteris	R						
Sagitta	C		F		F	R	F
Clio	C						
Firola	F			R		F	F
Hyalocylis striata		F	C		M	M	M
Creseis		R	C				R
Cavolina longirostris			M				
Atlanta				R			
Clionopsis grandis				R			
Diaca quadridentata						R	R
Limacina inflata							A
Cymbulia sibogae					A		

150—Fathom Plankton (*Continued*)

	26 T4	29 T1	31 T1	51 T2	59 T7	61 T2	74 T2
Glaucus			2				
Ostracods (small white)						C	F
Ostracods (orange)	F				F	F	F
Copepods (small pink)				C	F	M	
Eucalanus elongatus	A			M			R
Pontella			C		R		
Sapphirina	F		R				F
Mysids			R		R		
Candace					R		
Hyperids	M		A				
Phronima					M	M	M
Oxycephalids							R
Gammarids (orange)							F
Other Amphipods	R	R	A	F	F		
Euphausiids		C				A	R
Brachyura megalops		1					
Nauplius		1					
Phyllosoma			3				
Squilla larvae	F						
Salpa			C				R

## 200—Fathom Plankton

	49 PT1
Sagitta (large, transparent)	R
Limacina inflata	C
Limacina lesueuri	C
Creseis acicula	M
Creseis conica	M
Copepods (Small pink)	M
Pontella	M
Mysids	R
Euphausiids (small, white)	C
Euphausiids (pale pink)	1
Megalops	A
Phyllosoma	Z
Squilla larvae	C

## 300—Fathom Plankton

	26 PT1	28 PT1	51 T3 PT1	59 T3	59 T8	61 T3	66 T1	68 T2	74 T3	74 T14	74 T18	84 T1	84 T7	84 T11
Medusae (transparent)						R								
Beroe (small)								R					R	
Pleurobrachia								R						
Atolla													R	
Diphyes														R
Siphonophores						C				R		R		R
Pelagothuria														R
Annelids (brown)														
Annelids (pink)													F	F
Sagittia (large white)	C			R			R						F	
Sagittia (pink)			R	R			R							
Firola	M	F	F	R		R	R							R
Clio	M								R					
Diactra quadridentata									R					
Diactra trispinosa			R											
Cavolina uncinata			R							R				
Clionopsis grandis			R											
Cymbulia sibogae					F									
Cresels acicula							R							
Hyalocylis							R					R		
Atlanta							R							
Glaucus														
Ostracods (orange)				R			R		C	R				
Copepods (small pink)				A			R				F		F	



300—Fathom Plankton (*Continued*)

	26 PT1	28 PT1	51 T3	51 PT1	59 T3	59 T8	61 T3	66 T1	68 T2	74 T3	74 T14	74 T18	84 T1	84 T7	84 T11
Copepods (large red)	F			F	F										
Eucalanus					A	A	A	A	M	A		M	F	F	A
Pontella										R			F		
Lucifer										R					
Gnathophausia (small red)															
Phronima			R	R	R	R								R	
Amphipods (orange)				F	F				R						R
Hyperids					R										
Oxycephalids										R			R	R	
Gammarids (orange)													F		
Amphipods (transparent)							F								
Amphipods (pale slate)							M								
Euphausiids (pink patches)			R			C		M	A	C	R	F			F
Euphausiids (small white)						M					C	F	A		
Other Schizopods	C														
Macrurids (red and white)															
Megalops (red)														R	R
Shrimps (scarlet)	M				F										
Shrimps (orange)	F														
Salpae	M									R					
Doliolum	A				M										
Pyrosoma					R										
Halobates									R <sup>1</sup>				R <sup>2</sup>		

## 400—Fathom Plankton

	50 T2	56 T1	68 T3	84 T8	84 T19	86 T1	87 T2
Ctenophores (orange)		R		F			
Beroe (pink)				R			
Atolla				R			
Actinarians (orange)				F			
Siphonophores	R						
Porpita	R <sup>2</sup>		R <sup>1</sup>				
Pelagothuria						R	R
Annelids (large white)				R			
Sagitta (large white)	R						F
Eukrohnia (pink)	F	Ni		R	R	F	F
Firola			R				
Cymbulia		R			R		F
Clio pyramidata	F				F	R	
Clionopsis krohni					R		
Limacina	F						
Hyalocylix	F						
Creseis conica	F						
Creseis acicula	R						
Atlanta	R						
Limacina	R						
Cavolina	R						
Diacra trispinosa	R						
Cymbulopsis	F						
Glaucus	R <sup>3</sup>		R <sup>2</sup>				
Ianthina	R <sup>1</sup>						
Squids			R				
Ostracods	F		F				
Copepods (large red)	F			M	F	F	M
Eucalanus	A		A		M	C	F
Pontella	R						
Gnathophausia willemoesia		R				F	R
Isopods (black)						R	R
Hyperids	F	F					
Phronima	F			R			
Gammarids (pink)						M	
Oxycephalids			R	M		F	R
Other Amphipods (white)	M						

400—Fathom Plankton (*Continued*)

	50 T2	56 T1	68 T3	84 T8	84 T19	86 T1	87 T2
Amphipods (orange)					R	R	
Euphausiids (adults)	M	M	M	F	M	C	M
Macrurids (red)		F			F		F
Lucifer	M						
Eryoneicus						R	
Squilla (larvae)	R						
Salpa			R				

## 450—Fathom Plankton

	74 T7	74 T15	74 T19	84 T3	84 T9	84 T13	87 T3
Actinians (orange)					R		
Periphylla					R		
Hydromedusae (white)	R						
Hydromedusae (yellow)			R				
Siphonophores		R		R			
Ctenophores		R					
Beroe				R			R
Annelids (orange)		R			M		
Eukrohnia (orange)	F		F		R		
Clio balantium	R						
Cymbulia	R						
Diacra quadridentata		R					
Peraclis			R				
Firola				F	R		
Ostracods (red)	F		R	R			
Copepods (red zone)	M	F		C		C	
Eucalanus		A	M			A	
Mysids (red)	R						
Gnathophausia (small red)			R	F	F	F	
Hyperids (small pink)		R					
Gammarids (orange)					R		
Phronima	R	R	R				
Oxycephalids	R	R		R	R		
Amphipods (large red)	F	R	F				R
Euphausiids (red)	R	F	F				
Euphausiids (small white)		A					
Eucopa (deep red)							R
Macrurids (red and white)					F	F	

## 450—Fathom Plankton (Continued)

	74 T7	74 T15	74 T19	84 T3	84 T9	84 T13	87 T3
Megalops (pink)				F			
Lucifer				F			
Shrimps (small red)			R				
Benthophausia (orange)					F		
Squilla (larvae)				R		R	
Isopods (brown)	R		R	F			

## 500—Fathom Plankton

	59 T4	59 T9	61 T4	66 T2	74 T4	74 T8	74 T27	84 PT1	84 T10	84 T14	84 PT3	84 T20	86 T2
Medusae (small white)		M										.	
Pleurobrachia (pink)		C	F		R								
Beroe (pink)			R			R		R	F	R			
Periphylla			R										
Atolla					F	R							
Actinians (larval scarlet)										M			
Annelids (yellow)										F			
Annelids (orange)	F												
Sagitta (salmon)	M	M	M	M	F	F	F	R				F	R
Sagitta (transparent)	R		F										
Planarians (orange)		R											
Nemertians													R
Firola	R		F	F	R			R		R	R		R
Peraclis													
Creseis conica				R									
Creseis acicula				R									
Atlanta				R									
Clio pyramidata				R								F	
Clio balantium			R										
Hyalocylix				R									
Peracles			F				F						
Clionopsis krohni								R					
Cymbulia												R	
Octopus (fragile red)			R										
Ostracods (orange)	F		F		M					R			
Gigantocypris (small)													R G
Copepods (pink, red)	M	R	F	M	F	M	F	F				C	F
Eucalanus	M			C	C		C			C		M	C



500—Fathom Plankton (*Continued*)

	59 T4	59 T9	61 T4	66 T2	74 T4	74 T8	74 T27	84 PT1	84 T10	84 T14	84 PT3	84 T20	86 T2
Calanids (small)	C												
Mysids (orange, red)			R		M							R	
Gnathophausia					R			C		C	C		R
Isopods (black)		R			F	F		R	F			R	F
Phronima		R		R				R					
Gammarids (orange, pink)		R		F		F	F			R			M
Gammarids (slate color)		R											
Oxycephalids						R	R						M
Euphausiids (white)	C	M					F						C
Euphausiids (pink patches)	F			F	M								
Schizopods (scarlet)								M					
Porcellana (larvae)								R					
Macrura (red and white)								C			C	F	R
Macrura (large, snow white)											F		
Eryoneicus								R					
Magalops (black, red)			R									R	R
Shrimps (small red)	R		F	F	R					R			
Shrimps (large red)	F		F		F								
Squilla (post larval)											R		
Salpa (small blue)													A
Salpa zonaria			R										
Doliolum	F												

## 550—Fathom Plankton

	74 T20
Atolla	F
Eukrohnia (red)	F
Diacra quadridentata	R
Eucalanus	A
Gnathophausia (small)	R
Mysids (red larvae)	R
Isopod (black)	R
Oxycephalids	R
Amphipods (fragile pink)	R
Euphausia (pink and white)	M
Benthophausia	F
Shrimp (small red)	R

600—Fathom Plankton

	59 T5	59 PT1	59 T10	59 PT2	61 T5	61 PT1	66 T3	66 PT1	68 T5	68 PT1	74 T5	74 PT1	74 T9	74 PT2	74 T16	74 PT3	74 T21	84 T21	86 T3	87 T5
Ctenophores											R				R					R
Hydromedusae (pink)																				
Bolina											F									
Periphylla					R				R		R									
Pleurobrachia						F	F							R						
Afolla												R								
Siphonophores											R									M
Diphyes													F							
Actinians (small pink)																			R	
Annelids (orange)					F						R								R	
Annelids (white)							R													
Sagitta (transparent)			F		F				F						F					
Sagitta (pink)	F	C	M	M	M	C	M	M	F		M	R	F		F		F			F
Tomopteris											R									
Nomertians (orange)																	R			
Firola			R			F	F	R		R	R				R					R
Atlanta	R		R				F											R		
Cymbulla			R	F				R												
Hyalosyllis striata			R															R		
Olio pyramidata																		F		
Cresels acicula							F													
Cavolina uncinata							R	R				F				R	R			
Peracis															R	R	R			



600—Fathom Plankton (Continued)

	59 T5	59 PT1	59 T10	59 PT2	61 T5	61 PT1	66 T5	66 PT1	68 T5	68 PT1	74 T9	74 PT1	74 T9	74 PT2	74 T16	74 PT3	74 T21	84 T21	86 T3	87 T5
Phyllosomes																				
Macrurans (red)						R					R							R	R	
Benthophausia (red)																				
Shrimps (large red)	R	M		M				C	F	C	F	F		R	R	R	R			
Squilla (larvae)				R				R		C		F				F				
Doliolum						F				F										
Appendicularia					F															
Salpa zonaria (purple)																				
Halobates	R <sup>1</sup>						R <sup>1</sup>					R	R	R						



## 700—Fathom Plankton

	33 PT1	83 T22	84 PT4	87 T6	87 PT1
Actinians (larvae)		R			
Siphonophores					
Eucopa (deep wine color)				R	
Atolla wyvilli	R				
Halicrecas papillosum	F				
Homoconema typicum	R				
Aequorea globosa	R				
Siphonophore	R			M	
Annelids (yellow)		R			
Sagitta (transparent)	M				
Sagitta (salmon)	C	F		M	
Nemertean		R			
Firola	R		R	R	R
Atlanta	R	R	R		
Cavolina tridentata				R	
Cavolina uncinata			R		
Clio pyramidata	R	F	C		
Clio cuspidata				R	R
Cymbulia		F	F		
Squid (red)		R		R	
Ostracods (pink)	R				
Gigantocypris agassizi			R		
Copepods (large pink)	M			F	
Eucalanus		M		M	
Gnathophausia			F		
Gnathophausia brevispinis				R	F
Mysis		R			
Amphipods (pink)	F				
Hyperids	R				
Oxycephalids			R		
Gammarids (pink)				F	
Macrurus (red and white)			M		R
Megalops (large)	R				
Porcellana (zoea)	R				
Zoea (long-spined)	R				
Benthophausia		R			
Shrimp (red)					R

700—Fathom Plankton (*Continued*)

	33 PT1	83 T22	84 PT4	87 T6	87 PT1
Squilla (larvae)	R.	R	R		
Salpa cylindrica	R.				
Euphausiids		M	M	F	M

## 800—Fathom Plankton

	50 T3	50 OT1	53 T2	56 PT1	86 T4
Ctenophores					R
Annelids (pink)	R				
Sagitta (large transparent)	R		M	R	
Sagitta (pink)	F		R	R	F
Creseis conica	M		M		
Creseis acicula	F				
Clio pyramidata	F		R		
Clio balantium			R		
Hyalocylis	R		R		
Firola			R		F
Cymbulia					R
Ianthina	R <sup>1</sup>				
Squid					R
Ostracods (small orange)			R		
Gigantocypris			R		
Copepods (red)	M		M		M
Eucalanus	A				
Pontella	F				
Gnathophausia (red)			R	F	F
Isopod (black)	R			R	
Hyperids (white)	M				
Hyperids (red)				R	
Oxycephalids					R
Gammarids (orange)					M
Euphausiids (red)			M	F	M
Schizopods (pink)	M				
Macrurans (red)			R	R	R
Benthophausia (orange)			R		
Shrimp (red)	R	R		F	
Squilla (larvae pink)		R			
Salpae	F				

## 1000, 1100, and 1200—Fathom Plankton

	1000 fathoms 86 T5	1100 fathoms 53 T1	1200 fathoms 50 T4
Beroe (small pink)			R
Atolla	F		
Pelagothuria	F		
Sagitta (large transparent)		F	M
Sagitta (pink)	F	F	
Firola	R		
Atlanta		R	
Cavolina longirostris		R	
Creseis conica		R	
Creseis acicula		R	
Notabranchia		R	
Hyalocylix striata		R	
Clio pyramidata			A
Eucalanus	C	A	
Gnathophausia (large red)	F		R
Isopods (black)	R		
Amphipods (pink fragile)			F
Gammarids (pink)	C		
Gammarids (orange)	F		
Oxycephalids	M		
Euphausiid (pink)			R
Euphausiids (white)	C	F	F
Porcellana (large)			R
Benthophausia (red)	F	F	
Shrimps (large red)		M	F
Squilla (post larva)			R
Ostracods (scarlet)	R		

VII. RELATIVE ABUNDANCE OF FIFTY-SEVEN GROUPS OF INVERTEBRATES IN  
PACIFIC SURFACE HAULS

	Number of Occurrences in 47 Hauls	Abundant	Common	Many	Few	Rare	Relative Abundance based on 10-7-5-3-1 Ratio
Siphonophores	14	2	2	2	3	5	58
Porpita	13		1	2	8	2	43
Hydromedusae*	6	1		1	3	1	25
Ctenophores	8	1		1	5	1	31
Liriope	5		2		2	1	21
Stomatoca derissa	3			1	2		11
Mneopsis	1	1					10
Pleurobrachia	1		1				7
Physalia	1					1	1
Sagitta	31	7	8	7	7	2	184
Annelids	3				2	1	7
Creseis conica	17		5	2	8	2	71
Creseis acicula	12		5	3	3	1	60
Atlanta	9	1		3	1	4	32
Glaucus	12			2	6	4	32
Ianthina	11			2	5	4	29
Diacra quadridentata	7	1		1	2	3	24
Firola	7		1	2	1	3	23
Gastropod larvae	2	2					20
Limacina	4	1	1			2	19
Hyalocylix striata	5			1	4		17
Squid	8			2		6	16
Clio	5			1		4	9
Cavolina uncinata	5				1	4	7
Cavolina longirostris	2				1	1	4
Cymbulia	2					2	2
Peracles	1					1	1
Pneumoderma boasi	1					1	1
Euphausiids	30	6	9	4	11		176
Pontella	30	2	6	11			117
Copepods, small	13	7	4	1	1		106



Relative Abundance of Fifty-seven groups (Continued)

	Number of Occurrences in 47 Hauls	Abundant	Common	Many	Few	Rare	Relative Abundance based on 10-7-5-3-1 Ratio
Megalops	19	3	1	4	8	3	84
Phyllosomas	18	2	3	3	5	5	76
Hyperids	17	1	3	3	7	3	70
Squilla larvae	15	1	2	2	5	5	54
Lucifer	12	1	1	4	5	1	53
Zoea	10	2	1	1	2	4	42
Amphipods	8	1		2	5		35
Eucalanus	10	1		2	4	3	35
Mysids	6	1	2		3		33
Calanus	3	3					30
Monops	7		2		4	1	27
Schizopods	3	1	1		1		20
Sapphirina	3		1	1	1		15
Macrurus larvae	3		1	1	1		15
Candace	3		1		1	1	11
Acartia	1	1					10
Ostracods	1		1				9
Isopods	4				1	3	6
Gammarids	1				1		3
Hippa larvae	3					3	3
Sergestes larvae	2					2	2
Phronima	1					1	1
Halobates	27			5	21	1	89
Salpae	13	3	5		4	1	78
Doliolum	1				1		3
Pyrosoma	1					1	1

VIII. RELATIVE ABUNDANCE OF SIX MAJOR GROUPS OF INVERTEBRATES IN FORTY-SEVEN SURFACE HAULS IN THE PACIFIC

Crustacea	1033	52.4 per cent
Mollusca	367	18.7 per cent
Coelenterata	207	10.5 per cent
Annelida	191	9.7 per cent
Insecta	89	4.5 per cent
Urochorda	82	4.2 per cent

